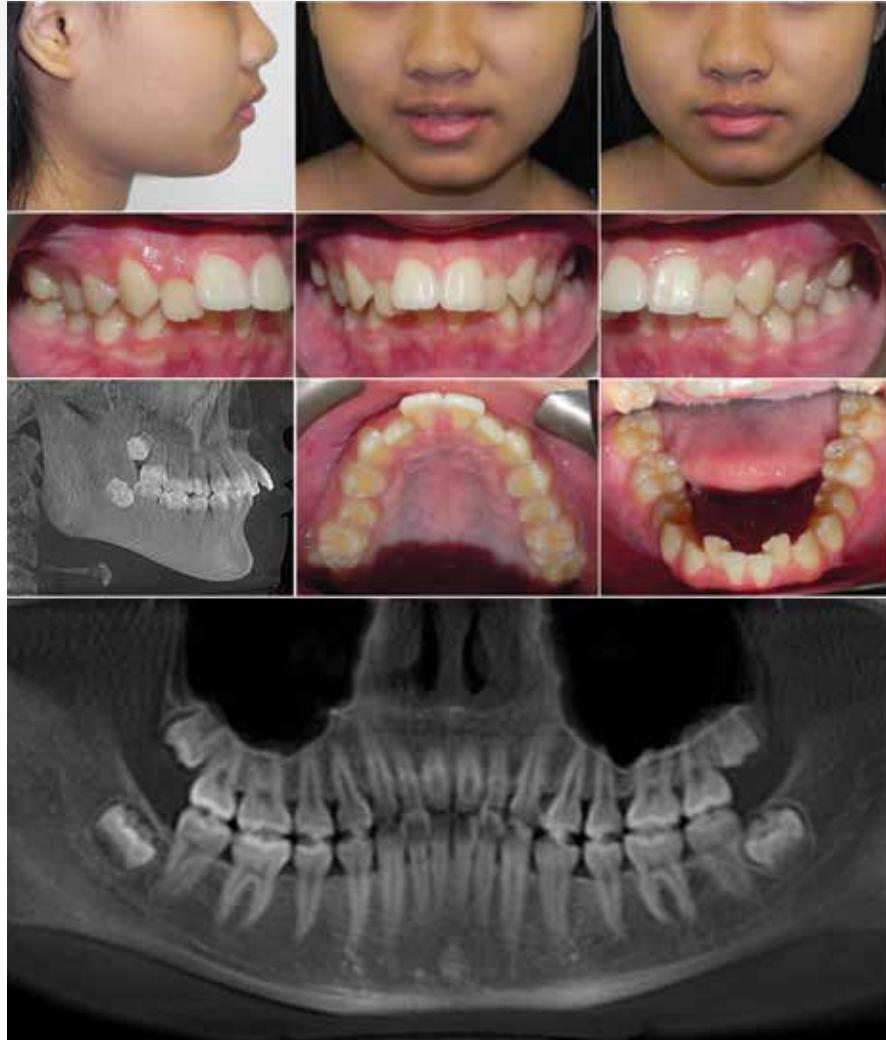


Teen orthodontic treatment with clear aligners

Sean Holliday¹



Initial records

Patient

Age: 15 year-old female. **Chief concern:** The patient was concerned about her crooked teeth, overbite, and upper teeth that were sticking out.

Diagnosis

- Class II, Division 1 malocclusion: severe on the right side, moderate (end-on) on the left side
- Severe overjet (8 mm), with proclined upper incisors ($U1-PP = 135^\circ$; norm = 110° , SD 6°) and upright lower incisors ($IMPA = 91^\circ$; norm = 90° , SD 5°). Note: these are estimated values since the imaging was not a full-volume CBCT.
- Class I skeletal pattern
- Moderate overbite
- 5 mm curve of Spee depth
- Moderate upper and lower crowding
- Constricted upper and lower arches
- No dental or periodontal problems

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Treatment goals

1. Non-extraction correction of the Class II malocclusion and the crowding
2. Reduce the upper incisor proclination
3. Level the curve of Spee
4. Widen the smile

Treatment plan

1. Dentoalveolar expansion of the arches to correct the crowding without extractions or enamel recontouring/ interproximal reduction (IPR).
2. Upright the upper central incisors.
3. In the lower arch, intrude the incisors and upright the premolars and molars to level the curve of Spee.
4. Coordinate the arches for Class I occlusion achieved through Class II elastics use (i.e., create a Class I set up

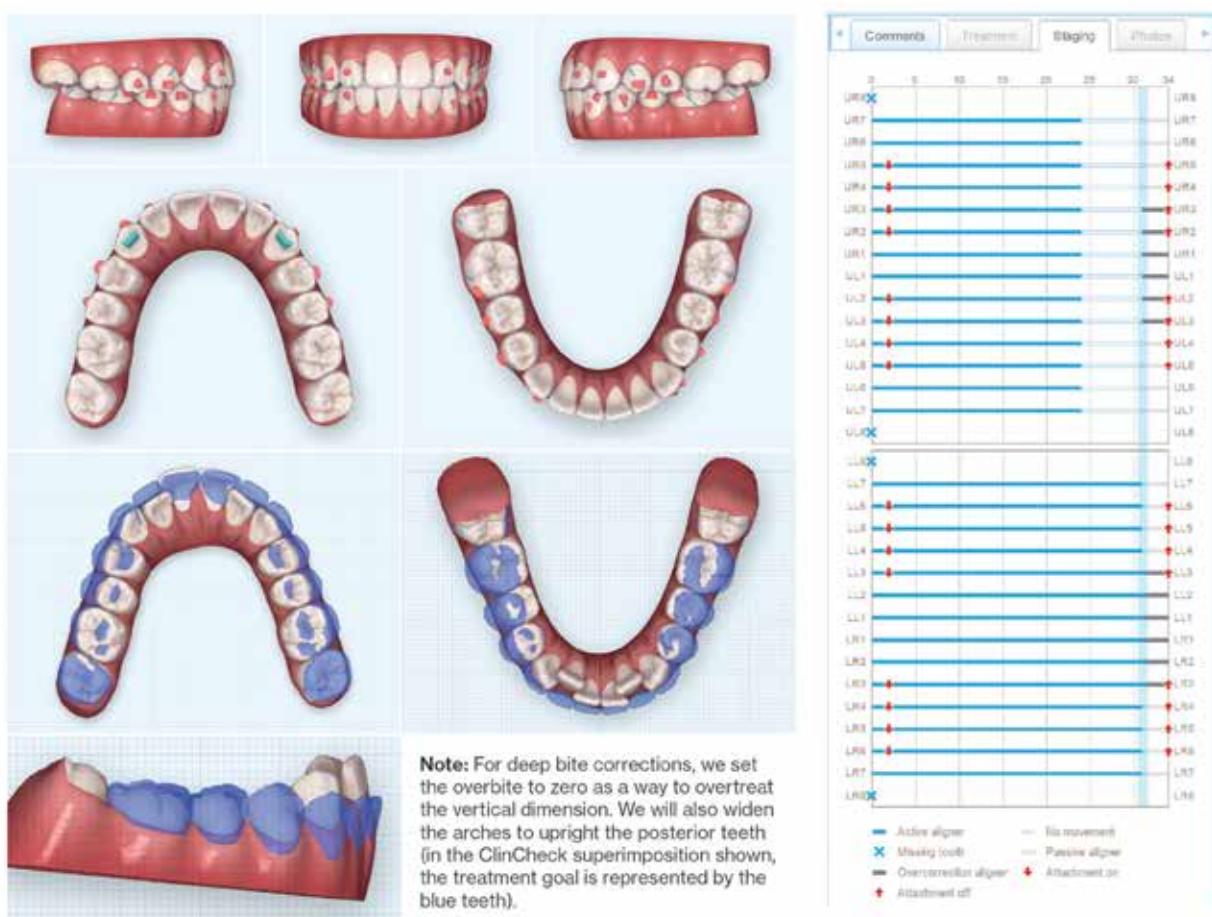
with a simulation of elastics-use (i.e., "bite jump") rather than upper distalization in the staging).

5. Post-treatment retention.

Invisalign aligner features used

- Optimized attachments for premolar extrusion and rotation, canine tip control, and lateral incisor and canine extrusion;
- Lingual pressure areas from lower canine to canine (3-3) to assist in the deep bite correction;
- Conventional attachments for aligner retention;
- Lingual bite ramps on the upper canines to enhance vertical control of the lower canines;
- Precision cuts on the upper first premolars and the lower first and second molars for Class II elastics;
- Elastics-use simulation ("bite jump") to visualize the Class II correction in the set-up.

ClinCheck® set-up and staging



Progress records



Progress after 31 upper (24 active and 7 passive) and 31 lower aligners. Additional aligners were ordered to fine-tune the anterior alignment and continue improvement of the overjet through additional leveling of the curve of Spee. Three stages of overcorrection aligners (in addition to the 31 initial U/L aligners) were worn while the additional aligners were being prepared.

Treatment summary

- The patient was very pleased with her Invisalign treatment outcome. This is noticeable when comparing the final smile photo to the initial smile photo. Before, she was self-

conscious of her smile, and the treatment results greatly improved her confidence. She was also happy to have experienced her orthodontic treatment without brackets and wires. The patient's parents were also very happy to

Final results



Final results of Invisalign treatment after 12 additional upper and 12 additional lower aligners (3 stages of overcorrection aligners were ordered with the additional aligners, but not used). The total treatment time was 24 months, from initial scan to retainer delivery. The initial aligners were changed every 2 weeks, and the additional aligners changed weekly.

see the improvement in their daughter's smile, and they were impressed with her compliance with aligner wear.

- The Class II, Division 1 malocclusion, protrusion, and crowding were corrected with 31 + 12 upper and 31

+ 12 lower Invisalign aligners, plus 3 stages of U/L overcorrection during the time between the initial and additional aligners. Good aligner wear compliance and oral hygiene were maintained throughout treatment.



Photographic superimposition (using the mandible as the reference) of the initial and final radiographs shows proclination of the lower incisors and relative lingual crown retroclination/buccal root torque of the upper incisors. Cephalometric superimposition was not possible because full-volume CBCT images were not taken.

- The initial aligners were changed every 14 days. The additional aligners were changed weekly. The total treatment time was 24 months from the initial scan to retainer delivery, with scheduling delays and missed appointments adding 8 weeks and 6 weeks to the treatment time, respectively.
- The patient's incisor positions were improved by controlling their inclination. Uprighting the upper incisors, reducing the overjet, and increasing the interincisal angle resulted in a favorable change to the patient's facial profile.
- For retention, upper and lower Invisalign retainers were ordered from the last stage of the additional aligners set-up (with no overcorrection). Our teenage patients are instructed to wear their retainers full-time for two weeks, followed by 8-hours of wear a day (typically at night), indefinitely.
- The total number of patient appointments from initial aligner placement to retainer delivery was 9:
 - Appointment #1 was for delivering the initial aligners and the use and care instructions.
 - Appointment #2, all attachments were bonded and Class II elastics were started. For improved esthetics (and therefore, better wear compliance), elastics in the upper arch were connected to the upper first premolars.

- Appointment #s 3-6 were aligner delivery visits (6 stages given per visit).
- Appointment #7 was for progress records and intraoral scanning for additional aligners.
- Appointment #8 was for delivery of additional aligners (all 12 stages).
- Appointment #9 was for attachment removal, final records, and retainer delivery.
- The patient had no emergency orthodontic visits.

Clinical notes

Our teenage Invisalign patients today are being treated with weekly aligner changes for all their aligners instead of changes every 2 weeks. We also deliver all the sets of aligners to the patient once we bond attachments. This improves the treatment time, since scheduling delays and rescheduled or missed appointments will not impede patient progress. The patient can continue to make progress without having to wait until their next aligner delivery appointment. However, this approach only works if no IPR is needed mid-treatment. In our teen patients, we do not use IPR in our treatment plans very often. In teens, we prefer using arch expansion and incisor inclination control instead. IPR in teens is usually only planned if a significant Bolton discrepancy is present.

The treatment time for this case was extended because of a missed appointment in the first series of aligners and a delay in delivering the additional aligners. These scheduling issues added almost 4 months to the treatment time. The initial aligners in this patient were worn on a 14-day schedule, which also prolonged the treatment time. Now that our patients are changing their aligners weekly, a similar case today would typically take 18 to 20 months to complete.

Using the iTero® scanner for digital impressions is also critical to creating an efficient treatment workflow and an improved patient experience. Digital impressions are accurate, time effective, and provide additional software tools that allow the doctor to evaluate the occlusion and tooth movement changes more efficiently. The clinical workflow is also streamlined by avoiding physical shipping of impressions and delays from any rejected impressions.

For efficiency, we also no longer delay bonding attachments until the second visit. We bond any and all attachments on the first visit, because the SmartTrack® aligner material has excellent elasticity which allows the patient to comfortably place and remove their aligners, even with attachments on the teeth. Class II elastics are also started at the same appointment when attachments are bonded. Placing precision-cut hooks in the aligners near the upper first premolars helps with elastics wear compliance, since they are not as visible as when they are attached near the upper canines.

Today, we also do not build virtual c-chain for overcorrection into our initial aligners. This is to avoid uncontrolled intrusion if the interproximal contacts are already touching (which happened with LR1 in this case).

If any overcorrection is needed, we will build it into specific areas during the additional aligners phase.

Typical challenges with using fixed appliances in a case like this include the higher probability of excessive lower incisor proclination and protrusion. Using Class II elastics in fixed appliance cases also tends to increase the vertical dimension. Aligners provide excellent lower incisor torque control, and by connecting the elastics to the aligners instead of directly onto the teeth in order to minimize molar extrusions, we have had better vertical control with clear aligner therapy.

Special section: Management of Class II, Division 1 teenage patient treatment with Invisalign aligners

We prefer to treat Class II patients with Invisalign aligners during their teenage years, since orthodontic treatment during the growth phase is usually more efficient and effective than treatments during adulthood. The difference between treating Division 1 and Division 2 teen patients is that the upper incisors in Division 2 patients often need torque, but to avoid significant roundtrip movements of the upper incisors, molar distalization is first needed to gain space. In our Division 2 patients, the aligner staging pattern will involve molar distalization and an "esthetic start" (early initial alignment of the anterior teeth). In our Division 1 patients, the aligner staging will consist of arch development and alignment, followed by a mandibular "bite jump" to simulate the effects of Class II elastics use. Otherwise, we set up both types of Class II cases similarly in terms of bite relationship goals.

The advantage of being able to visualize the Class I occlusion in the ClinCheck® digital treatment plan is that the interdigitation of the teeth can be optimized in the Class I position. This allows for better planning of archform changes. Expansion movements can also be coordinated between the arches from the very beginning of treatment. Another advantage of the ClinCheck software program is the superimposition feature which shows the patient's initial condition with the plan simultaneously. If the lower incisors need to be advanced beyond an acceptable range for periodontal health, IPR or extractions may be considered instead. The main advantage of no IPR and non-extraction treatment plans in teens is efficiency in the clinic. Invisalign treatment does not necessarily require IPR, especially in the younger patients with healthy periodontal support. Arch development and proper incisor control can minimize the need for IPR and/or extractions. Extraction treatments can take a long time to finish, due to the increased amount of tooth movements and added case complexity, so a non-extraction approach can be a more efficient path in comparison, when appropriate.

In Class II patients, my general preference is to level the curve of Spee in the set-up through lower premolar extrusion (by approximately 0.5 mm), and to intrude the lower canines to the level of the mesial marginal ridge of the lower first premolars. The lower central and lateral incisors should be positioned in the set-up based on the mesial contact point of the lower canines as the guide. In brachyfacial and mesofacial patients, our cases are set-up with posterior extrusion and anterior intrusion. In dolichofacial patients, posterior extrusion is often not desirable. Greater vertical control is desired in patients with dolichofacial patterns to prevent the lower face height from increasing. If the patient has a deep bite, the overbite will be set up to zero mm as a way to overtreat the vertical dimension. We can also widen the arches to upright the posterior teeth instead of extruding them.

For growing teen patients, we almost always set up the treatment plan with a "bite jump" elastics simulation, where the mandible comes forward in the set-up, instead of the upper arch going back. The exceptions are in cases where the canines are blocked-out, or in Class II Division 2 cases where molar distalization is planned, since distalization decreases roundtripping and proclination of the upper incisors (when supported with elastics). Non-growing patients often need more time for Class II correction and

elastics wear. Since adult patients cannot benefit from the sagittal improvements of mandibular growth, posterior IPR or upper premolar extractions may need to be considered as well. Adult patients who need a longer time in elastics for Class II correction may also benefit from distalization plans, because these staging patterns produce more aligners than those where a bite jump from elastics use and mandibular growth is planned.

Class II elastics are started at the same appointment when attachments are bonded. The entire clinical team needs to reinforce to the patient that elastics are critical for improving the bite correction, and teenagers generally comply much better when they understand the impact that elastics use can have on their treatment outcome. Precision-cut hooks (mesial) are placed near the upper first premolars so the patient can connect the elastics to the aligners more distally, which is esthetically better and hopefully leads to better elastic wear compliance. This configuration also does not affect the use of optimized attachments on the upper canines, which are important for aligner retention and for correcting rotations. Precision-cut hooks (distal) in the lower aligner are placed on the first

and the second molars for redundancy. The preference is to run Class II elastics from the upper first premolar to the lower second molars, but if the lower aligner lifts from elastics pull, they are connected to the lower first molars instead.

The use of attachments for aligner retention is also critical when elastics are used. Retention attachments on the first premolars and the first molars are preferred. In the past, 3 mm occlusal-beveled horizontal attachments were used, but today, the optimized retention and optimized extrusion attachments are preferred.

We also add bite ramps to the lingual surface of the upper aligners as a vertical rest and focal point of contact for the lower canines. The bite ramps are built into the aligners rather than bonded on the teeth, so they are very convenient to implement into the treatment plan. The upper bite ramps are designed to aid in the intrusion of the lower canines, and the intrusion force generated on the lower canines from the patient's natural bite also supports any incisor intrusion programmed into the aligners. They also help keep occlusal forces away from the posterior teeth, which then facilitates any posterior extrusion planned.